

The following are themes that arose from responses submitted to the Request for Information (RFI): Occupational Safety and Hazardous Substances Training in Emerging Technologies ([NOT-ES-12-007](#)). These summaries were written by SRP staff based on the responses received as an effort to remove duplication in responses and to protect the anonymity of the respondents. The Superfund Research Program wishes to thank all respondents.

Information that was requested:

- Emerging industries or fields that could benefit from training in occupational safety and hazardous substances training (e.g., nanotechnology, remediation (chemical, physical, and biological), and exposure sciences (assessment; biology; sensor technology)).
- Current level of awareness of existing or potential training and education in emerging technologies.
- Current health and safety principles and strategies that may be applied to industrial hygiene and occupational safety in emerging industries.
- Perceived level of need for training and types of courses deserving of focus on emerging technologies.
- Gaps and challenges in research, technology, and general knowledge of occupational threats related to emerging technologies in industrial settings

Emerging industries or fields that could benefit from training in occupational safety and hazardous substances training (e.g., nanotechnology, remediation (chemical, physical, and biological), and exposure sciences (assessment; biology; sensor technology)).

- Responses included oil extraction industries, green technologies (e.g., production of new products in the computer, energy, and construction industries), materials science (e.g., nanotechnology), mining industry, and pharmaceutical and personal care product production.

Current level of awareness of existing or potential training and education in emerging technologies.

- The level of awareness of available training and education opportunities may be limited in smaller and newer organizations, which often do not have the resources or experience to offer training.
- Workers' knowledge may be limited of how Personal Protection Equipment (PPE) functions to protect their health and safety and how long PPE can be used while performing a job function before disposal. There is also a need for determining how PPE may affect/interfere with operation of large industrial equipment.
- There is limited knowledge of how emerging technologies/contaminants may impact the health of unprotected workers, homeowners, and other occupants who remain on-site or return before a site and the materials used have been properly cleaned, disposed, or allowed to fully cure.
- Identification of best work practices is needed to prevent exposures to products manufactured by emerging technologies/industries.
- Education and training in emerging technologies is necessary as Universities and industry continue to promote and become aware of the development of emerging products and technologies, especially if manufacturing of products is expanded in large-scale operations.

Current health and safety principles and strategies that may be applied to industrial hygiene and occupational safety in emerging industries.

- At this time, occupational and environmental health specialists are trained in advanced-level programs to learn concepts that can be applied to any existing or emerging field. Workers can apply principles such as application of the precautionary principle, control banding, and the hierarchy of control to reduce exposures.
- There is a need to develop uniform certification training programs for some emerging industries.
- Training in emerging technologies should be interdisciplinary and should focus on the fundamental properties and design (e.g., engineering, physics, and chemistry) of novel materials that are used in these technologies. Other training areas include the ethical, societal, and economic impacts of emerging technologies.
- As emerging technologies continue, there should be constant surveying of the safety practices and perceptions of students and faculty working in various work settings.
- Tools that may be used to distribute information about potential exposures from emerging technologies include web-based tools to describe the potential hazards of products from emerging industries and recommended laboratory safety controls and procedures.

Perceived level of need for training and types of courses deserving of focus on emerging technologies.

- There is an extensive need for occupational and safety training in emerging technologies and continued education on the lifecycle of novel chemicals/products/hazardous waste due to the high level of uncertainty in these areas. Training should also include an understanding of the fundamental chemical, physical, and structural properties of new materials as well as fate, transport, transformation, and potential ecotoxicity of these products
- There is no uniform training, licensing, or job inspection requirements for the rapidly growing emerging technology industry. As the industry continues to expand, there will be a continued need for a trained workforce in this employment sector. Many employers and organizations place a high value on a workforce with flexibility to apply their knowledge of emerging technologies to the workplace.
- Courses for undergraduate students, industrial hygiene graduate students, doctoral students, and professionals requiring continued education should be focused on protecting the human health and the environment. Training for industrial hygienists, for example, should include industrial hygiene principles and common job responsibilities so that students are prepared to take full responsibility for managing hazardous materials created by emerging technologies.
- Doctoral-level training in occupational and safety training in emerging technologies could assist in the development of research programs to determine the magnitude of exposure to hazardous chemicals/processes and potential for human toxicity. This training will also have long-term benefits for health and safety in emerging industries, and allow these new investigators to become the future leaders in the environmental and occupational health profession.
- Schools of Public Health need to be engaged in providing training for the next generation of occupational and environmental health specialists on issues associated with emerging technologies. Many of these programs already train students and professionals in industrial hygiene, hazardous materials and waste management, and injury prevention.
- Information from various government agencies should be incorporated into occupational and safety health training and education (e.g. Environmental Protection Agency's "Design for the

Environment" program and Department of Defense's evaluation of emerging contaminants as a part of its Chemical and Material Risk Management Program).

Gaps and challenges in research, technology, and general knowledge of occupational threats related to emerging technologies in industrial settings.

- A primary challenge is the consideration of health and safety risks during the research and development phase of products/processes. The identification of problems earlier in the process could potentially save resources. Another concern is the long-term health and safety challenges of working with emerging technologies.
- As new products, industries, and processes emerge, the life-cycle management of materials is important to consider. This management includes: the consideration of the use a product in a manner that it was not intended; the potential for a product or process to become less safe over time; and the safe disposal of the product.
- There is a need to develop a comprehensive training program that includes communicating best practices that addresses the proper use and disposal of PPE, awareness of state and federal regulations as new technologies develop, advanced control technologies, and knowledge of all potential exposure routes. Other methods that should be considered in these programs include: existing and novel exposure measurement tools, how to measure exposure from all routes, biomonitoring, measurement of internal dose, and environmental monitoring methods.
- Consideration needs to be given to small start-up companies developing emerging technologies. These start-up companies may not have employees with sufficient health and safety training or education. Also, for both small and large businesses, technology development may be proprietary and therefore potential hazards may not be recognized by those outside the business.
- Due to a broad and diverse audience, training in emerging technologies will require multiple educational strategies and approaches. This training should be interdisciplinary and should include concepts and ideas from experts in engineering, chemistry, materials science, toxicology, and social science. A combination of didactic and experiential training is optimal for training on emerging contaminants/processes.